

Data User Guide

GPM Ground Validation NASA S-Band Dual-Polarimetric (NPOL) Doppler Radar Wallops Flight Facility (WFF)

Introduction

The GPM Ground Validation NASA S-Band Dual-Polarimetric (NPOL) Doppler Radar Wallops Flight Facility (WFF) dataset consists of rain rate, reflectivity, Doppler velocity, and other radar measurements obtained from the NPOL doppler radar positioned at the Wallops Flight Facility (WFF) in support of the Global Precipitation Mission (GPM). NPOL was developed by scientists at WFF and is a fully transportable and self-contained S-band (10 cm), scanning dual-polarimetric Doppler research radar that was placed near Newark, Maryland between GPM GV missions. Data files are available from December 6, 2013 thru April 28, 2017 in Universal Format (UF), with browse files in PNG format containing images of corrected radar reflectivity, differential reflectivity, specific differential phase, co-polar correlation, and Doppler velocity images. Data are tarred into daily collections of files and zipped for storage and quick download.

Notice:

This dataset does not have continuous data. Data are missing for various dates that are listed in the user guide.

Citation

Wolff, David B., David Marks, Walter A. Petersen, and Jason Pippitt. 2018. GPM Ground Validation NASA S-Band Dual Polarimetric (NPOL) Doppler Radar Wallops Flight Facility (WFF) [indicate subset used]. Dataset available online from the NASA EOSDIS Global Hydrology Resource Center Distributed Active Archive Center, Huntsville, Alabama, U.S.A. doi: http://dx.doi.org/10.5067/GPMGV/WFF/NPOL/DATA101

Keywords:

NASA, GHRC, WFF, Wallops, GPM, Maryland, NPOL, S-band, Radar, RHI, PPI, precipitation, radar reflectivity, co-polar correlation, differential reflectivity, differential phase, spectrum width, doppler velocity, rain rate

Campaign

The Global Precipitation Measurement (GPM) mission Ground Validation (GV) campaign used a variety of methods for validating GPM satellite constellation measurements prior to and after launch of the GPM Core Satellite, which occurred on February 27, 2014. The GPM instrument validation effort included numerous GPM-specific and joint agency/international external field campaigns, using state of the art cloud and precipitation observational infrastructure (polarimetric radars, profilers, rain gauges, and disdrometers). Surface rainfall was measured by very dense rain gauge and disdrometer networks at various field campaign sites. These field campaigns accounted for the majority of the effort and resources expended by GPM GV. More information about the GPM mission is available at https://pmm.nasa.gov/GPM/.

Instrument Description

The NASA S-Band Dual Polarimetric (NPOL) Doppler Radar was located for operation near Newark, Maryland (38.263N, 75.342W) between use on GPM GV field campaigns. NPOL was developed by the research team at Wallops Flight Facility. This instrument is a fully transportable and self-contained S-band (10 cm), scanning dual-polarimetric Doppler research radar that takes accurate volumetric measurements of precipitation including rainfall rate, particle size distributions, water contents and precipitation type. Two different scan types are used: Plan Position Indicator (PPI) - 360 degree sweep of the antenna and Range Height Indicator (RHI) -scans pointing at a specific azimuth with the antenna tilted upward to get vertical profile information. The scanning strategy emphasized vertical structure sampling via RHI and narrow sector-volume data collections, as well as frequent 3-minute full PPI rain scans for rain mapping. More information about the NPOL Doppler radar is available at the Precipitation Measurement Missions NPOL website.

The NPOL doppler radar scans a section of the atmosphere while also transmitting pulses in two directions (horizontal and vertical) and returns 3D images. The image data can be used to discern size, shape, and distribution of raindrops in clouds. The data aids scientists in better understanding the physics of rainfall.



Figure 1: Image of the NPOL Doppler radar (Image Source: <u>Precipitation Measurement Missions NPOL website</u>)

Investigators

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Data Characteristics

The GPM Ground Validation NASA S-Band Dual-Polarimetric (NPOL) Doppler Radar Wallops Flight Facility (WFF) data are available in Universal Format (UF) at a Level 1B processing level. More information about the NASA data processing levels are available here. Information needed to read UF files with IDL is available at the GHRC. The associated browse images are in PNG format and contain plots of corrected radar reflectivity, differential reflectivity, specific differential phase, co-polar correlation, and Doppler velocity images. All data files for a single day are tarred and zipped into daily files.

Table 1: Data Characteristics

Characteristic	Description
Platform	Ground station
Instrument	NASA S-Band Dual Polarimetric (NPOL) Doppler radar
Projection	n/a
Radar Location	N: 38.263, W: 75.342
Spatial Coverage	N: 39.622, S: 36.899, E: -73.627, W: -77.106 (Maryland)
	150 km radially from radar location
Spatial Resolution	125 m - 300 m
Temporal Coverage	December 6, 2013 - April 28, 2017
Temporal Resolution	Daily
Sampling Frequency	3-10 minutes
Parameter	Radar reflectivity, co-polar correlation, Doppler velocity,
	rain rate
Version	1
Processing Level	1B

File Naming Convention

The GPM Ground Validation NASA S-Band Dual-Polarimetric (NPOL) Doppler Radar Wallops Flight Facility (WFF) dataset consists of daily tarred files containing data files in UF format with the file naming conventions shown below. The associated browse images are available in PNG format.

Tarred Data files: wallops_npol_YYYY-MMDD.tar.gz **Untarred Data files:** npol1_YYYYMMDD_hhmmss.uf

Tarred Browse files: wallops_npol_images_YYYY_MMDD.tar.gz

Untarred Browse files:

 $wallops_npol1_YYYYMMDD_hhmmss_[CZ|DR|KD|PH|RH|VR]_[sw\#\#|***.*AZ]_[PPI|RHI].png$

Table 2: File naming convention variables

Variable	Description
YYYY	Four-digit year
MM	Two-digit month
DD	Two-digit day
.tar.gz	Tarred and zipped data file
hh	Two-digit hour in UTC
mm	Two-digit minute in UTC
SS	Two-digit second in UTC
.uf	Universal Format
	CZ: Corrected Radar Reflectivity
	DR: Differential Reflectivity
[CZ DR KD PH RH VR]	KD: Specific Differential Phase
	PH: Differential Phase
	RH: Co-polar Correlation

	VR: Doppler Velocity
[sw## ***.*AZ]	sw##: Elevation angle (only for PPI mode) ***.*AZ: Azimuth angle (only for RHI mode)
[PPI RHI]	PPI: Plan Position Indicator mode RHI: Range Height Indicator mode
.png	Portable Network Graphics

Data Format and Parameters

The GPM Ground Validation NASA S-Band Dual-Polarimetric (NPOL) Doppler Radar Wallops Flight Facility (WFF) data consists of radar reflectivity, Doppler velocity, rain rate, and other radar-related direct and derived parameters. These files are in UF format. More information about UF formats is available in Barnes, 1980. Information needed to read UF files with IDL is available at the GHRC. Table 3 describes the acronyms and units for each parameter. Table 4 describes the classifications for the Hydrometeor Identification parameter.

Table 3: Data Fields

Parameter	Acronym	Unit
Radar Reflectivity	ZZ	dBz
Corrected Radar Reflectivity	CZ	dBz
Co-polar Correlation	RH	-
Differential Reflectivity	DR	dB
Differential Phase	PH	degrees
Specific Differential Phase	KD	degrees/km
Spectrum Width	SW	m/s
Signal Quality Index	SQ	-
Doppler Velocity	VR	m/s
Hydrometeor Identification (see Table 4)	FH	-
Normalized Intercept Parameter (DM)	NW	-
Median Volume Diameter	D0	mm
Normalized Intercept Parameter (D0)	N2	-
DROPS2 Rain Rate	RR	mm/h
Pol ZR Rain Rate	RP	mm/h
Cifelli 2002 Rain Rate	RC	mm/h

Table 4: Hydrometeor Identification Classifications

·	Classification	Acronym
Unclassified		UC
Drizzle		DZ
Rain		RN
Ice Crystals		CR
Dry Snow		DS
Wet Snow		WS

Vertically-aligned Ice	VI
Low-density Graupel	LDG
High-density Graupel	HDG
Hail	НА
Big Drops	BD

Algorithm and Quality Assessment

The GPM Ground Validation team developed a processing algorithm that uses quality controlled radar data and is based on dual polarization parameters that are both modular and physically based. This helps to determine if an echo is precipitating. The Dual Polarization Quality Control (DPQC) algorithm can be applied to PPI and RHI scan types to allow users to easily view and manipulate the data. The output of this algorithm is the quality controlled radar structure in UF, as well as plots of quality controlled radar fields and a quality controlled parameter file. More detailed information about the DPQC algorithm is available in Pippitt et al., 2013. The NASA NPOL Doppler Radar calibrates as it is collecting data. More information about the calibration process and data quality can be found in Chandrasekar et al., 2008.

Software

These data files are in UF format. The UF format is the common Doppler radar data exchange format described at <u>UCAR (document based on a 1980 BAMS publication)</u>. No special software is needed to read these UF data files; however, <u>Panoply</u> is an easy-to-use free tool for reading and visualizing the data within these UF files. More information about reading UF files with IDL is available at the <u>GHRC</u>.

Known Issues or Missing Data

This dataset does not have continuous data. Table 5 lists days for which there are no data. The NPOL instrument only operates during days of rain. Missing data may be due to no rain, instrument shutdown or malfunction, or in the case of longer gaps, the transport of the NPOL instrument to be used in a GPM GV field campaign. Table 5 shows which dates have no data.

Table 5: Dates with missing data

1 4 5 1 2 4 4 6 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
Missing Data Dates
December 11, 2013
December 15, 2013
December 21, 2013
December 25-28, 2013
December 30, 2013
January 1, 2014
January 4-9, 2014
January 12, 2014

January 16 20 2014
January 16-20, 2014
January 23-27, 2014
January 30-February 2, 2014
February 4, 2014
February 6-11, 2014
February 17-20, 2014
February 22-28, 2014
March 5-6, 2014
March 9-11, 2014
March 15, 2014
March 21-24, 2014
March 27, 2014
April 1-July 31, 2014
August 5, 2014
August 7-9, 2014
August 13-21, 2014
August 23-September 6, 2014
September 10-December 28, 2014
December 30, 2014 - January 11, 2015
January 13, 2015
January 15-17, 2015
January 19-23, 2015
January 25-March 4, 2015
March 6-25, 2015
March 7-April 13, 2015
April 15-19, 2015
April 21-May 20, 2015
May 22-June 1, 2015
June 3-20, 2015
June 22-25, 2015
June 27-July 10, 2015
July 12-August 10, 2015
August 13, 2015 - March 9, 2016
March 11-17, 2016
March 21-May 5, 2016
May 7-June 2, 2016
June 4, 2016
June 7-November 3, 2016
November 5-7, 2016
November 11-13, 2016
November 16, 2016
November 18-28, 2016
December 2-4, 2016
December 8-10, 2016
December 0 10, 2010

December 15-16, 2016
December 20-26, 2016
December 28, 2016
December 30, 2016 - January 2, 2017
January 4, 2017
January 8-10, 2017
January 12, 2017
January 16, 2017
January 25-29, 2017
January 31-February 6, 2017
February 10-14, 2017
February 16-24, 2017
March 4-6, 2017
March 9, 2017
March 11-12, 2017
March 15-17, 2017
March 20, 2017
March 22-23, 2017
March 25-27, 2017
April 2-3, 2017
April 7-16, 2017
April 19, 2017

References

Barnes, Stanley L. (1980): Report on a Meeting to Establish a Common Doppler Radar Data Exchange Format. *BAMS*, 61:11, 1401-1404.

https://journals.ametsoc.org/doi/pdf/10.1175/1520-0477-61.11.1401

Chandrasekar, V. A., A. Hou, E. Smith, V. N. Bringi, S. A. Rutledge, E. Gorgucci, W. A. Petersen, and G. S. Jackson (2008): Potential Role of Dual-Polarization Radar in the Validation of Satellite Precipitation Measurements, *BAMS*, August 2008, 1127-1145. doi: https://doi.org/10.1175/2008BAMS2177.1

Related Data

The NPOL instrument was used in the GPM GV field campaigns: OLYMPEX, IPHEx, IFloodS, and MC3E. Each of these can be considered a related dataset. In addition, the NPOL instrument was also used in the CAMEX-4 and NAMMA field campaigns. To locate all GHRC NPOL instruments, enter "NPOL" into HyDRO.

GPM Ground Validation NASA S-Band Dual Polarimetric (NPOL) Doppler Radar OLYMPEX V2 (http://dx.doi.org/10.5067/GPMGV/OLYMPEX/NPOL/DATA301)

GPM Ground Validation NASA S-Band Dual Polarimetric (NPOL) Doppler Radar IFloodS V2 (http://dx.doi.org/10.5067/GPMGV/IFLOODS/NPOL/DATA102)

GPM Ground Validation NASA S-Band Dual Polarimetric (NPOL) Doppler Radar IPHEx (http://dx.doi.org/10.5067/GPMGV/IPHEX/NPOL/DATA101)

GPM Ground Validation NASA S-Band Dual Polarimetric (NPOL) Doppler Radar MC3E (http://dx.doi.org/10.5067/GPMGV/MC3E/NPOL/DATA101)

CAMEX-4 NASA Portable S-Band Multiparameter WX Research Radar (http://dx.doi.org/10.5067/CAMEX-4/SBAND/DATA101)

NAMMA NASA Polarimetric Doppler Weather Radar (NPOL) (http://dx.doi.org/10.5067/NAMMA/NPOL/DATA101)

Contact Information

To order these data or for further information, please contact:

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Huntsville, AL 35805 Phone: 256-961-7932

E-mail: support-ghrc@earthdata.nasa.gov

Web: https://ghrc.nsstc.nasa.gov/

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